Fetal intracranial cysts: prenatal diagnosis and outcome

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Abstract

Intracranial cysts are central nervous system malformations involving different brain regions, and commonly diagnosed during prenatal period by ultrasound scan (US). A malformative cyst is a nontumoral fluid-filled collection exerting a mass effect on the brain parenchyma and/or on the ventricles, regardless of its location within subarachnoid spaces, brain or ventricles, and of the nature of its limiting membrane, which is always unknown prenatally. Although a large number of case reports have been published, many uncertainties remain concerning their epidemiology, pathogenesis, and outcome. Most of these lesions, if not associated with other fetal anomalies, are benign in nature, remain clinically silent, do not evolve or even frequently regress spontaneously and do not impair physiologic neurodevelopment. The normality of the adjacent brain is the major argument in favour of a malformative lesion. The correct diagnosis is of crucial importance to exclude the presence of other rare lesions (e.g. cystic neoplasms or intracranial hemorrhage) that could negatively affect neurodevelopmental outcome of the child. To establish a correct prognosis all efforts must aim to precisely interpret the US images accurately analyzing the brain anatomy.

KEY WORDS: fetal, cysti brain, intracranial

Introduction

The US diagnosis relies on the presence of a hypoechoic mass of variable volume, shifting or lifting up the adjacent brain and/or ventricles. The quality of the images depends upon the gestational term, the fetal presentation, and the thickness of the mother's abdomen. According to a mere anatomical origin, intracranial cysts may be classified into three different categories: extra-axial, intraparenchymal, or intraventricular.

Cysts of extra-axial origin are mostly represented by the arachnoid cysts. Primary arachnoid cysts are filled with cerebrospinal fluid and they are usually not connected to the subarachnoid space (1). In contrast, secondary arachnoid cysts that result from hemorrhage, trauma, and infection, usually communicate with the subarachnoid space (2, 3). The common positions of these cysts are at level of main brain fissures, such as sylvian, rolandic and interhemispheric fissures, sella turcica, the anterior cranial fossa, and the middle cranial fossa on the surface of the brain (4). The walls of the cyst contain a thick layer of collagen and hyperplastic arachnoid cells but lack the trabecular processes characteristic of the normal arachnoid. They may be found anywhere over the brain surface and also inside the ventricular system. In children, common locations are the temporal fossa, the Sylvian fissure, and suprasellar or infratentorial regions. Interhemispheric cysts generally are associated with agenesis of the corpus callosum. In 5% to 10% of cases, the cyst may be located in the posterior fossa, resulting in upward displacement of the tentorium and vermis. However, in this case the anatomy of the cerebellum and the fourth ventricle remains normal, differentiating it from other posterior-fossa anomalies, such as the Dandy Walker malformation. Many cysts remain stable in size and do not compress vital brain structures. Occasionally, large arachnoid cysts can indent the underlying cortex and mimic a picture of lissencephaly. Although most arachnoid cysts are isolated findings they may sometimes be associated with metabolic diseases such as glutaric aciduria type 1. Most of arachnoid cysts reported in the literature (5, 6) were first diagnosed in the third trimester while only few cases were diagnosed during the second trimester. In a large study performed on a casistic of 54 fetuses (6) the majority of the arachnoid cysts were supratentorial, mostly placed in the interhemispheric fissure (25%); other common sites were the infratentorial region (22.2%) and the base of the crani-

um and the incisure. All the cysts were diagnosed between 20 and 30 weeks of gestation with the remaining 45% after 30 weeks. In the same study, at the 4 years follow up reported a good prognosis in 88% of the cases in terms of behavior, neurological development, and intelligence. Nine pregnancies were terminated because they were associated with other brain anomalies. Some reports describe complete resolution of the cysts 10 and cysts rarely progress postnatally. In most of these cases the diagnosis was made by ultrasound scan and magnetic resonance (MR) imaging, when performed, did not modify the original diagnosis. However, in selected cases prenatal MR imaging could help to demonstrate the anatomic details of other central nervous system abnormalities, such as compression of the aqueduct, communication between the cyst and the ventricles, and corpus callosum dysgenesis. Bretelle and coworkers (7) reported the presence of an isolated infratentorial cyst in a 13-week fetus with pathologic confirmation after termination of pregnancy at 15 weeks.

Among the intraparenchymal cysts, the periventricular pseudocysts, cystic periventricular leukomalacia, and the porencephalic cystic lesions are the most representative.

Various insults (e.g. ischemia, infection, hemorrhage) can result in cystic brain lesions. The prognosis depends on the presence of associated findings and on the extent and place of the insult. Periventricular pseudocysts (PVPCs) are commonly found at the level of the caudo-thalamic groove or of the caudate nuclei; they may be unilateral or bilateral and unilocular or multilocular. These cysts are probably the result of a small hemorrhagic event in the germinal matrix that liquefies upon resolution. PVPCs have approximately an incidence of 1% and a correct diagnosis should rule out cytomegalovirus infection or other anatomical anomalies such as the coarctation of the aorta, hemimegalencephaly, hypoplasia of the vermis with dysmorphism (8). In fact, in a study conducted on 11 fetuses, those with such additional pathologies did not survive (8). Other less common aetiologies found in association with PVPCs include cardiac malformations, chromosomal microdeletions (4p-), and metabolic or mitochondrial disorders (9). At least 50% of the cases represent isolated germinolytic events without development of any handicap in the affected children. Prenatal diagnosis of PVPCs is possible based on the demonstration of the cysts adjacent to the lateral ventricle. When diagnosed, PVPC warrants an extensive search for possible associated pathological findings. As an isolated finding, antenatal PVPC seem to carry a good prognosis. Although transabdominal US generally is sufficient to raise the suspicion of the presence of PVPCs, transvaginal US is more informative and help particularly in the differential diagnosis between this condition and periventricular leukomalacia (8).

Although cystic periventricular leukomalacia (PVL) is most common in premature newborns it may also occur in full-term newborns after an ischemic or hypoxic episode (10). Cystic PVL is the result of focal necrosis of the periventricular white matter, when the area of focal necrosis is large; the end result of the clastic process is cyst formation. The association between PVL and antenatal infection and inflammation has been studied extensively during the last decade (11, 12); maternal infection during pregnancy has been found to be very common among children developing cerebral palsy; 17 furthermore, histologic chorioamnionitisand congenital infection-related morbidity are more common among neonates with PVL than among those without PVL (12). Porencephalic cystic lesions occur after focal necrosis as a result of an ischemic event involving the vascular distribution of a single major cerebral vessel (10). In these cases, the prognosis is usually reserved. Pilu et al. (5) reported the prenatal diagnosis of severe porencephaly in a series of 10 fetuses; in nine fetuses the cysts were connected with lateral ventricles. Termination of pregnancy was performed in three fetuses, perinatal death occurresd in another three, and the remaining four children suffered from severe neurodevelopmental delay. Malinger et al. (13), has reported the natural history of a probable focal arterial stroke diagnosed at 23 weeks evolving into a porencephalic cyst. After birth the child was found to have a familial leukoencephalopathy. In another case, a large porencephalic cyst was found in association with brain disruption after a life-threatening car accident.

The choroid plexus cysts (CPC) are the most common form of intraventricular cysts. The choroid plexus, responsible for the production of cerebrospinal fluid (CSF), is composed of secory neuroepithelium that is present all through the ventricular system but is more prominent in the lateral ventricles. This type of epithelium is easily recognized by US as a hyperechogenic structure from 8 weeks of gestation. In the second trimester, the incidence of CPC has been estimated by several population studies to be 1% (14), while other studies have found the incidence to vary from 0.18% to 3.6% (15). Despite the low incidence, CPC has clinical implications for aneuploidy because of an association of choroid plexus with trisomy 18 (16). CPCs are generally found in the body of lateral ventricle choroid plexus but have been described in other parts of the lateral ventricles and also in the third ventricle. They are usually not observed before 17 weeks, and in the majority of patients they disappear before 26 weeks of gestation. They may be unilateral or bilateral, nonseptated or septated. CPCs are not lined by epithelium but consist of a distended mesenchymal stroma with distended angiomatous interconnecting thin-walled capillaries (17).

CPCs are considered having a benign nature and when isolated they do not increase the risk for chromosomal abnormalities. The observation of such a cyst recommend a complete search for associated anomalies with particular attention to the heart, brain, and hands, since in cases caused by trisomy 18 malformations in these organs have been reported (18, 19). Follow-up until their disappearance may be indicated because, although very rare, there is the possibility of the development of obstructive hydrocephaly caused by occlusion of CSF drainage through the Foramina of Monro in case of a large cyst (20). The differential diagnosis should exclude an intraventricular hemorrhage penetrating into the choroid plexus and other rare types of cysts like colloid or ependymal cysts.

Conclusions

The cysts can be found in different brain compartments

and may have different origins. Choroid plexus and arachnoid cysts are the most commonly diagnosed lesions and, when not associated to other fetal anomalies, have a good prognosis. Intraparenchymal cysts may have different aetiologies, and the prognosis depends largely on the site and on the extent of the lesion. It is of crucial importance to perform a meticulous US examination and correctly interpreting the images to exclude other similar non benign and/or additional lesions thus giving accurate counselling. In some difficult limited cases fetal brain MR imaging may be complementary.

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